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(54) **WHEEL RIM**

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B60B 15/18	(2006.01)
B60B 1/10	(2006.01)
B60B 15/02	(2006.01)

(52) **U.S. Cl.**
CPC ***B60B 25/00*** (2013.01); ***A01G 25/09*** (2013.01); ***A01G 25/092*** (2013.01); ***A01G 25/095*** (2013.01); ***A01G 25/097*** (2013.01); ***B60B 1/10*** (2013.01); ***B60B 1/14*** (2013.01); ***B60B 15/02*** (2013.01); ***B60B 15/18*** (2013.01); *B60B 2900/551* (2013.01)

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CPC ... B60B 1/10; B60B 15/18; B60B 2900/551; B60B 15/02; B60B 25/00; B60B 1/14; A01G 25/095; A01G 25/092; A01G 25/09; A01G 25/097
USPC 239/723, 726, 728, 731, 735, 741, 742, 239/744; 305/4; 301/43, 52, 53
See application file for complete search history.

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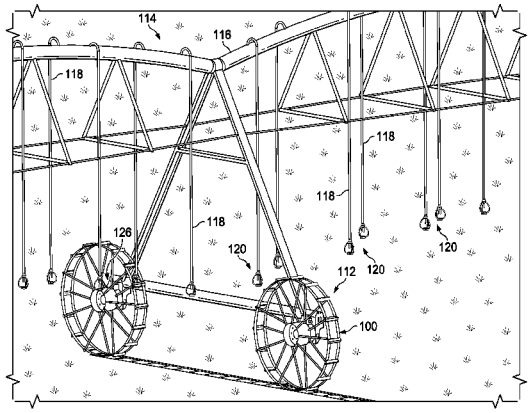
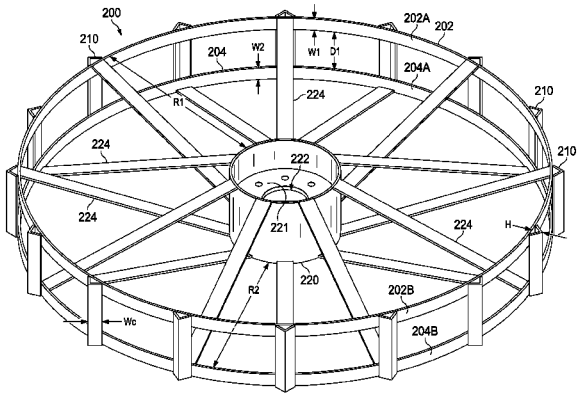
Primary Examiner — Steven J Ganey

(57) **ABSTRACT**

Various aspects of a wheel rim for use with agricultural equipment, such as an irrigation system are disclosed. In one example, the wheel rim includes first and second concentric rim plates separated by a distance, each of the first and second concentric rim plates having an outer surface. The wheel rim further includes a plurality of cross members spanning the distance.

17 Claims, 4 Drawing Sheets





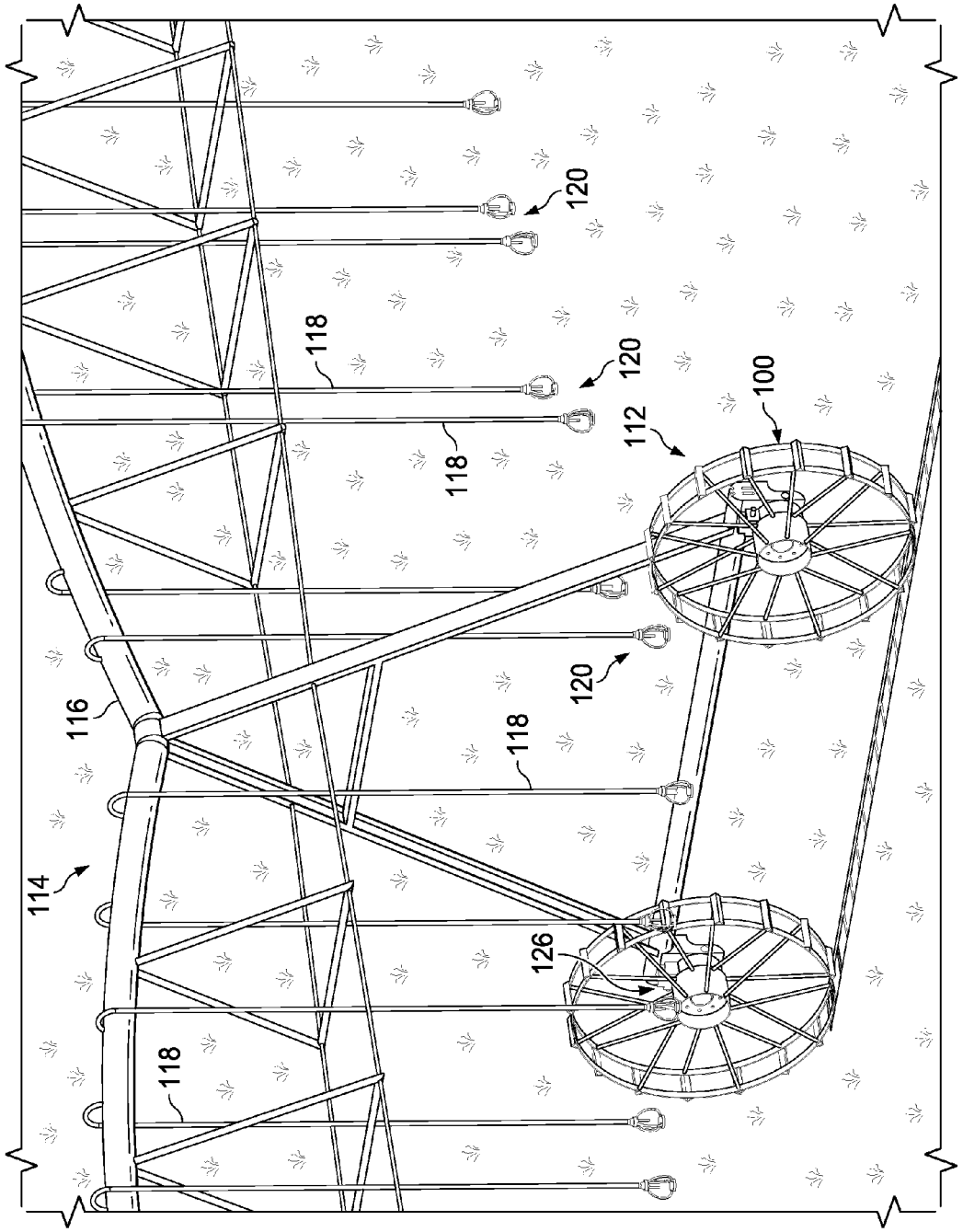
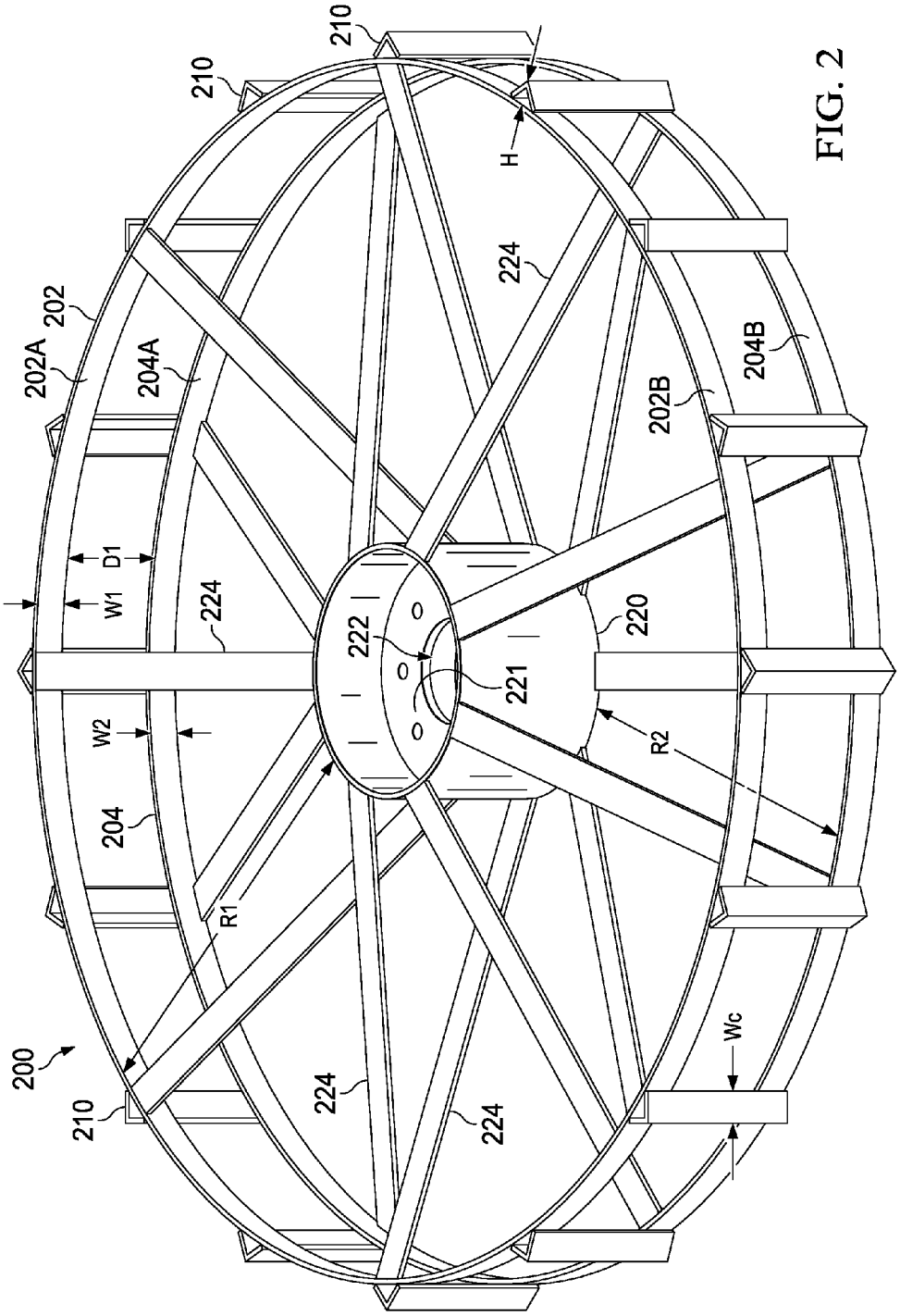


FIG. 1


210
210
H
224
202
202A
204A
202B
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221
220
W2
R2
204
R1
200
210
224
224
Wc

FIG. 2

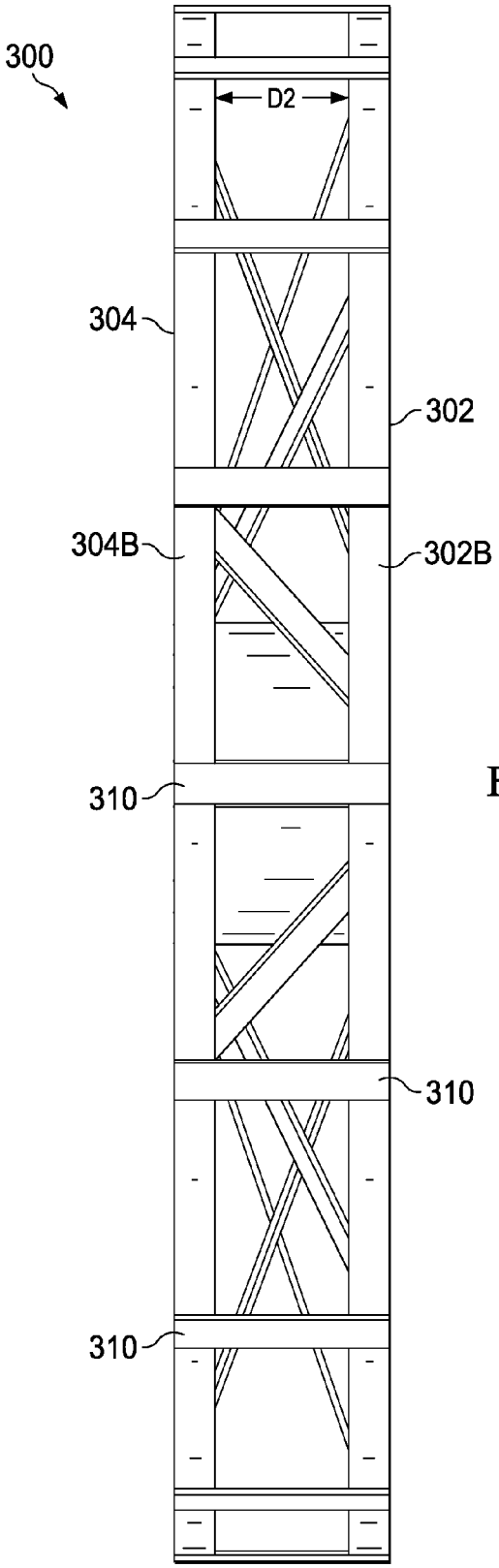

FIG. 3

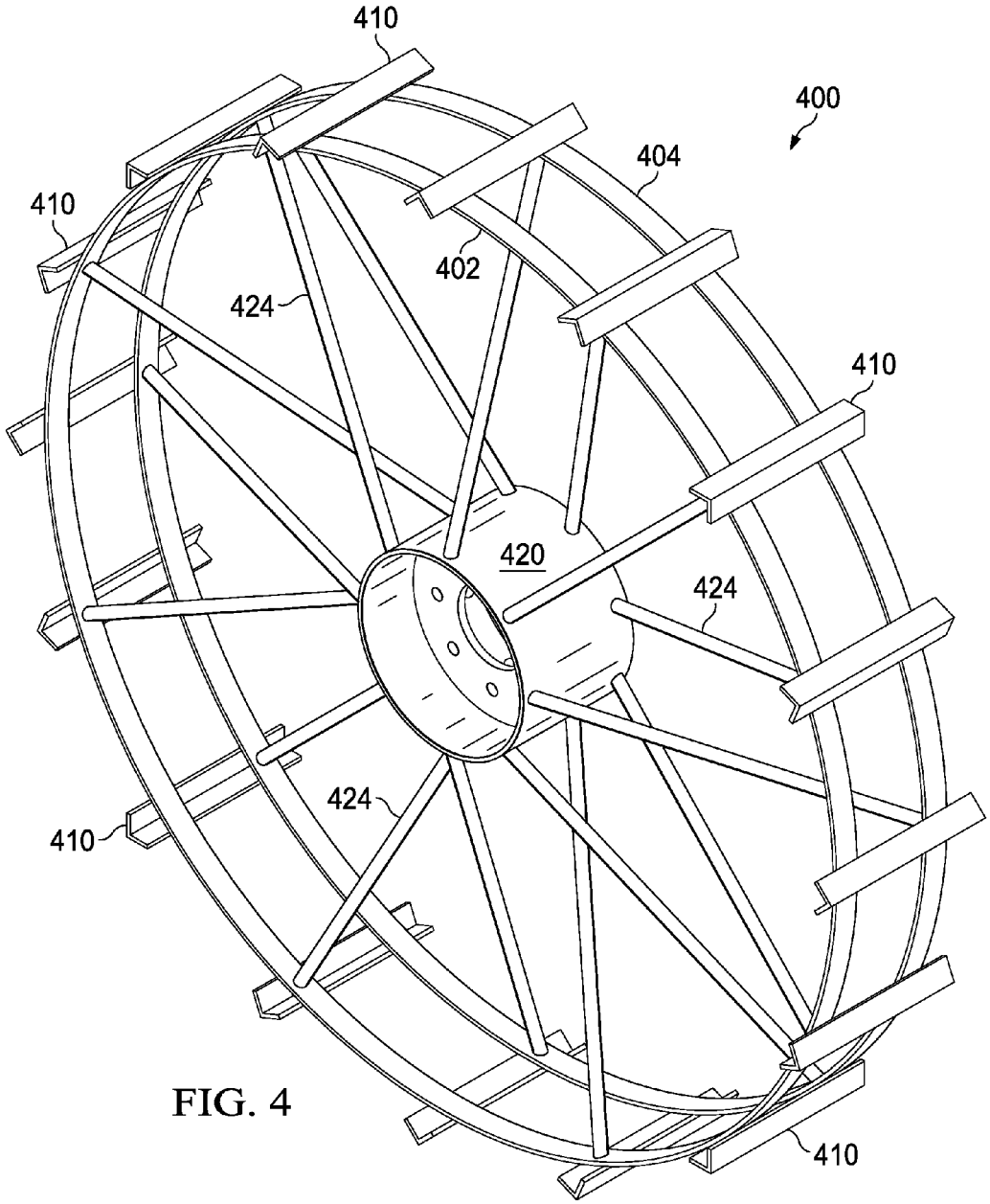

FIG. 4

WHEEL RIM

TECHNICAL FIELD

This application is directed, in general, to wheel rims and, more specifically, to a wheel rim for use with agricultural equipment having multiple concentric rim plates.

BACKGROUND

Agricultural equipment, such as irrigation systems, are used in a variety of climates and conditions. Irrigation systems, for example are designed to work in a variety of earth terrains and surfaces, most commonly, dirt and mud.

One example of an irrigation system includes a number of pipe spans connected to each other, having wheels mounted at various positions along the pipe span. The wheels move the irrigation system around a crop and recirculate about the same point at various intervals, depending on the crop size, but in many cases, the interval is usually measured in days. As the irrigation system rotates around the crop the crop begins to accumulate moisture both from the water delivered by the irrigation system, but also from natural sources. As the moisture beings to accumulate, the wheels tend to sink into the earthen surface such as mud and tend to push the mud forward. As a result, mud tends to accumulate, and in turn the ruts of the wheel grow deeper and deeper each time the irrigation system rotates about the crop.

Accordingly, what is needed is an irrigation system and more particularly a wheel design that can handle the mud better.

SUMMARY

Disclosed herein are various aspects of wheel rims. In one embodiment, there is a wheel rim comprising first and second concentric rim plates separated by a distance, each of the first and second concentric rim plates having an outer surface. The wheel rim further comprises a plurality of cross members spanning the distance.

An irrigation system is disclosed in another aspect of the present disclosure. The irrigation system, in this aspect, comprises a span connected with a water source, the span comprising at least one section of piping having sprinkler heads connected thereto. The irrigation system further comprises two wheels, each of the wheels comprising a wheel rim. The wheel rim comprises first and second concentric rim plates separated by a distance, each of the first and second concentric rim plates having an outer surface. The wheel rim further comprises a plurality of cross members spanning the distance. The irrigation system also comprises a drive system coupled to at least one of the two wheels.

BRIEF DESCRIPTION

Reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

FIG. **1** is an environmental view of an agricultural sprinkler system employing one embodiment of a wheel rim according to the present disclosure;

FIG. **2** is a perspective view of one embodiment of a wheel rim according to the present disclosure;

FIG. **3** is an end view of another embodiment of a wheel rim according to the present disclosure; and

FIG. **4** is a perspective view of yet another embodiment of a wheel rim according to the present disclosure.

DETAILED DESCRIPTION

Agricultural equipment is used in various weather conditions and terrain surfaces. Commonly, surface terrain and conditions of crops irrigated by continuously moving sprinkler irrigation systems, such as, e.g. center-pivot irrigation systems that rotate about the crop, tend to become muddy and soft. As a result, as typical irrigation systems continue to circle about the crops, the wheels sink and push through the mud, which causes the mud to accumulate and get deeper and deeper such that each time the wheel passes around the crops, the mud is deeper and deeper. Generally, the wheels are unable to continue moving at a same pace through the deeper mud because the wheel will generally sink further into the mud as the wheel pushes through. In addition, as the wheel encounters more and more mud, the resistance increases, which puts added stress and strain on each wheel, motor, and drive train of the irrigation system. As a result, certain wheels for equipment such as irrigation systems have tended to be configured with larger circumferences to accommodate sinking into and pushing more and more mud. However, while the larger circumference wheels are able to push through the mud and still maintain a minimum height for delivery of water to the crops, the larger circumference wheels still encounter increased resistance and therefore do not alleviate the stress and strain on each wheel, motor, and drive train of the irrigation system.

The present disclosure relates to a wheel rim for use with wheels for agricultural equipment, such as an irrigation system, the wheel rim configured to engage the earthen surface, such as mud, yet allow the mud to pass through the wheel rims rather than accumulate in front of the wheel rim. By allowing the mud and earth to pass through the wheel rims rather than accumulate in front, a wheel having the disclosed wheel rims may maintain a relatively similar pace through an irrigation cycle and still maintain a needed minimum height above the crop, thus more effectively irrigating the crop.

Referring now to the drawings and more specifically to FIG. **1**, there is shown one embodiment of a wheel rim **100** being used on wheels **112** of an irrigation system **114**. The irrigation system **114** comprises at least one span **116** which connects to a water source. In one embodiment, the span **116** has drops **118** with sprinkler heads **120** on the distal ends thereof. In some embodiments, the drops **118** may extend downward from the span **116** as shown, but other configurations of the span **116** and pipes **118** may be utilized, depending on the crop type and other considerations. For example, in one other embodiment, the sprinkler heads are located directly on the span **116**. At least one drive system **126** may be coupled onto at least one wheel **112** of the irrigation system **114** for driving one or more of the wheels **112** to move the irrigation system **114** around the crops.

Referring now to FIG. **2**, there is shown another embodiment of a wheel rim **200**. The wheel rim **200** comprises a first rim plate **202** and a second rim plate **204**, which is concentric with the first rim plate **202**. The first rim plate **202** and second rim plate **204** are separated by a distance D**1**, which may vary in size according to the type of agricultural equipment for which the wheel rim **200** may be utilized. The opening created by distance D**1** enables mud to move through and disperse through said opening such that the mud does not accumulate as the wheel rim **200** moves through and engages the mud. The first rim plate **202** and second rim

plate each have an inner surface **202**A and **204**A respectively, and an outer surface **202**B and **204**B, respectively.

A plurality of cross members **210** are positioned about the wheel rim **200**. The cross members **210** are configured to span distance D**1**. In another embodiment, the cross members **210** are configured to couple to the outer surfaces **202**B and **204**B of the first rim plate **202** and second rime plate **204**. As the wheel rim **200** rotates, the cross members **210** engage the mud and sink; however, as the cross members **210** engage and sink into the mud, the mud is pushed through the opening created by distance D**1** and disperses rather than accumulating in front of the wheel rim **200**. In the embodiment shown in FIG. **2**, the cross members **210** are configured having an angled edge such that the cross members **210** may engage and sink into the mud at least height H of the cross member **210** and also may provide better traction through the mud and various other surfaces and textures. The cross members **210** may also comprise various other shapes and configurations such as a solid triangular member, semi-circular edge, a flat planar member, a beveled edge, and other configurations suitable for engaging earth surfaces such as mud yet enable the mud to pass through and disperse.

The first rim plate **202** has a first width W**1** and the second rim plate **204** has a second width W**2**. In this embodiment, W**1** is about equal to W**2**; however, certain embodiments may be realized wherein varying sizes having varying radii and circumferences and widths may be utilized. Likewise, although the wheel rim **200** is shown having the first rim plate **202** with a radius R**1** and the second rim plate **204** with a radius R**2**, wherein R**1** is about equal to R**2**, some embodiments may utilize different sizes of rim plates having varying radii and thus varying circumferences. Similarly, the surfaces of cross members **210** may be configured having a width Wc which may be configured according to the width of the first rim plate **202** and second rim plate **204**. However, if configured as a flat planar member, width Wc may be greater and may be configured having a greater height H for deeper engagement with the mud. Various ratios of size, width, and height of the cross members **210** in relation to the first rim plate **202** and second rim plate **204** may be configured according to various crop types and configurations.

While wheel rim **200** is shown having the cross members **210** positioned at substantially equal intervals about the outer surfaces **202**B and **204**B of the first rim plate **202** and second rim plate **204**, the cross members **210** may be configured and spaced at varying intervals. Likewise, the quantity of cross members **210** may vary depending on the radii R**1** and R**2** of the first rim plate **202** and second rim plate **204**. Further, the number of cross members **210** may be greater or lesser in number according to the terrain and crop type.

The wheel rim **200** may further comprise a hub **220** at a center of the concentric first wheel rim **202** and second wheel rim **204**. The hub **220** may comprise an aperture **222** by which the wheel rim **200** may be mounted onto an irrigation system and likewise for attachment of a drive system, motor, and the like, or may be mounted onto piping of an irrigation system if the piping is configured to run through the center of the wheels such that the piping doubles and an axle between wheels of an irrigation system.

The concentric first rim plate **202** and second rim plate **204** may be connected with the hub **220** via a plurality of spokes **224**. The spokes **224** may be configured at alternating angles relative to the hub **220** such that every other spoke **224** is coupled with the first rim plate **202** and likewise the intermediate spoke **224** is coupled with the second rim plate **204**. By alternating the spokes **224**, even more space is created within the wheel rim **200** for dispersing the mud passed and pushed therethrough. The spokes **224** may align with the cross members **210** as shown in FIG. **2**, but as shown in the embodiment of the wheel rim **100** in FIG. **1**, the alignment and positioning of the spokes may be independent of the placement of cross members **210**. Further, the size and angle of the spokes **224** may vary, whereas the spokes **224** may be configured as relatively flat planar members as shown in FIG. **2**, but may also be configured with a cylindrical shape as shown in FIG. **1**.

The wheel rim **200** and components thereof may be constructed using a variety of materials and fabricating processes. The wheel rim **200** may comprise metals such as aluminum, iron, steel—either hot rolled or cold rolled, stainless steel, and the like such that the wheel rim **200** may support a load from the surrounding components of an attached irrigation system, yet be lightweight for portability and energy efficiency. The wheel rim may **200** may also be fabricated from high strength polymers and other materials configured for strength and durability. The cross members **210** may be coupled onto the first rim plate **202** and second rim plate **204** via welding, fasteners, and other suitable fastening processes known to those skilled in the art of manufacturing industrial and agricultural equipment. Likewise, if constructed from polymers, such as Poly (vinyl chloride), the first rim plate **202**, second rim plate **204**, and cross members **210** may be constructed using fasteners, couplings, and other suitable fastening processes suitable on industrial and agricultural equipment.

In some embodiments, wheel rim **200** may comprise 16 spokes **224**. In other embodiments, the number of spokes may correspond with the radius of the largest rim plate. The ratio of spokes to radius may be within a range of about 0.4 to about 0.8. In accordance with the disclosure, such a ratio of spokes to radius provides superior strength, weight and cost attributes. Outside of such a ratio of spokes to radius, at least one of the strength, weight or cost will fall short. In the given embodiment of FIG. **2**, the radius R**1** is 25 inches, and 16 spokes **224** have been used, resulting in a ratio of spokes to radius of about 0.64 spokes per inch of radius R**1**. For larger wheel rims **200**, additional spokes **224** may be required, and for smaller wheel rims **200**, fewer spokes **224** may be required. The spokes **224** may be constructed in some embodiments using ⅝" cold rolled steel rod. The rod size may increase or decrease in size, such as, e.g., the rod size may increase to between ¾" to 1" in size for heavy duty applications for which the wheel rim **200** may be used, and other materials such as hot rolled steel or aluminum may also be used.

In some embodiments, first rim plate **202** and second rim plate **204** may be constructed using ⅜"×2" hot rolled steel flat bar. Accordingly, the size and/or thickness of the flat bar may increase or decrease according to the application or terrain for which the wheel rim **200** may be used. In other embodiments, A cold rolled steel material may be used instead of hot rolled steel. The cross members may be fabricated using a 2" by 2" by 3/16" hot rolled steel angle iron, but similar to the material for the first rim plate **202** and second rim plate **204**, a wider and/or thicker material may be used or a cold rolled material.

The hub **220** may comprise a 12¾" well casing having an inner hub plate **221** of ⅜" hot rolled steel flat plate. Similar to the radius and size of the first rim plate **202** and second rim plate **204**, the size, thickness, and width of the hub and inner hub plate **221** may vary according to an irrigation

system on which the wheel rim **200** may be used and also according to the application or terrain for which the wheel rim **200** may be used.

Referring now to FIG. **3**, there is shown another embodiment of a wheel rim **300** according to the present disclosure. Wheel rim **300** is constructed similarly to wheel rim **200** and having similar components and accordingly likewise comprises a first rim plate **302** and a second rim plate **304**. The first rim plate **302** and second rim plate **304** are separated by a distance D2 and have cross members **310** coupled on outer surfaces **302**B and **304**B thereof. The cross members **310** are configured having a flat planar surface, wherein the cross members may be fabricated having similar dimensions as first rim plate **302** and second rim plate **304**, such as, e.g., a similar thickness and height.

Referring now to FIG. **4**, there is shown another embodiment of a wheel rim **400** according to the present disclosure. Wheel rim **400** may include features similar to wheel rims **200** and **300** and may likewise be constructed using similar materials, dimensions, and ratios. Wheel rim **400** comprises a first rim plate **402** and a second rim plate **404**. The first rim plate **402** and second rim plate **404** have cross members **410** coupled thereonto. In this embodiment of wheel rim **400**, the cross members **410** extend beyond the outer edges of the first rim plate **402** and second rim plate **404**, which may provide additional support or traction, among other benefits. Spokes **424** are formed having a rounded, cylindrical shape and are coupled between wheel hub **420** and the first rim plate **402** and second rim plate **404**. In this embodiment, every other spoke **424** couples to the wheel hub **420** and the first rim plate **402** and likewise the alternating spoke **424** couples to the wheel hub **420** and the second rim plate **404**.

Those skilled in the art to which this application relates will appreciate that other and further additions, deletions, substitutions and modifications may be made to the described embodiments.

What is claimed is:

1. A wheel rim, comprising:

first and second concentric rim plates separated by a distance, each of said first and second concentric rim plates having an outer surface, wherein said first and second concentric rim plates are parallel and substantially within the same plane;

a plurality of cross members spanning said distance and positioned entirely above said outer surface of each of said first and second concentric rim plates; and

a hub, wherein said first and second concentric rim plates are coupled to said hub via a plurality of spokes, said plurality of spokes coupled to an inner surface of each of said first and second concentric rim plates;

wherein said plurality of spokes are configured to extend outward from a center of said hub at alternating angles such that said plurality of spokes couples alternatively to only one of said first and second concentric rim plates.

2. The rim according to claim **1**, wherein the plurality of cross members are coupled to said outer surface of each of said first and second concentric rim plates, and further wherein each of said first and second concentric rim plates has a width.

3. The wheel rim according to claim **2**, wherein said distance is at least two times said width.

4. The wheel rim according to claim **2**, wherein said distance is substantially similar to said width.

5. The wheel rim according to claim **2**, wherein said distance is about three times said width.

6. The wheel rim according to claim **2**, wherein each of said plurality of cross members has a width substantially similar to said width of each of said first and second concentric rim plates.

7. The wheel rim according to claim **2**, wherein each of said plurality of cross members has a width greater than said width of each of said first and second concentric rim plates.

8. The wheel rim according to claim **2**, wherein said width is greater than said width of each of said first and second concentric rim plates.

9. The wheel rim according to claim **1**, wherein said plurality of cross members are positioned at substantially similar intervals about said first and second concentric rim plates.

10. The wheel rim according to claim **1**, wherein each of said plurality of cross members is configured having an angled surface that protrudes upward from said outer surface of said first and second concentric rim plates.

11. The wheel rim according to claim **1**, wherein each of said plurality of cross members comprises a substantially flat surface.

12. The wheel rim according to claim **1**, wherein said first concentric rim plate has a first width and said second concentric rim plate has a second different width.

13. An irrigation system, comprising:

a span connected with a water source, said span comprising at least one section of piping having sprinkler heads connected thereto;

two wheels, each of said wheels comprising a wheel rim comprising:

first and second concentric rim plates separated by a distance, each of said first and second concentric rim plates having an outer surface;

a plurality of cross members spanning said distance and positioned entirely above said outer surface of each of said first and second concentric rim plates; and

a hub, wherein said first and second concentric rim plates are coupled to said hub via a plurality of spokes, said plurality of spokes coupled to an inner surface of each of said first and second concentric rim plates;

wherein said plurality of spokes are configured to extend outward from a center of said hub at alternating angles such that said plurality of spokes couples alternatively to only one of said first and second concentric rim plates; and

a drive system coupled to at least one of said two wheels.

14. The irrigation system according to claim **13**, wherein each of said plurality of cross members is configured having an angled surface that protrudes upward from said outer surface of said first and second concentric rim plates.

15. The irrigation system according to claim **13**, wherein said plurality of cross members are positioned at substantially similar intervals about said first and second concentric rim plates.

16. The irrigation system according to claim **13**, wherein each of said plurality of cross members has a width and wherein said width is substantially similar to a width of each of said first and second concentric rim plates.

17. The irrigation system according to claim **13**, wherein said plurality of cross members are coupled to said outer surface of each of said first and second concentric rim plates.

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